various monitoring techniques have progressed well beyond their state of development in the early 1970s. In addition, new methods, such as modulated backscatter, have come to the fore.

As described above, AMTECH devices have been deployed in hundreds of locations across the country. Several other licensees of diverse LMS technologies have operational systems and, like AMTECH, are in the process of building new ones to meet the increasing demand for monitoring service and for intelligent vehicle highway systems of various types. Given the success to date of the interim regulations in promoting broad and diverse AVM development,[44] it would further the public interest for the FCC to maintain the principle of spectrum sharing.

The *NPRM* tentatively concludes that sharing would be in the public interest, but proposes to segregate "wideband" (904-912 and 918-926 MHz) and "narrowband" (902-904, 912-918, and 926-928 MHz) systems. There is no public interest basis for doing so. As explained above, diverse monitoring systems have developed over the past 20 years despite the absence of such segregation in the interim AVM regulations. Moreover, in any new LMS regime, maximum flexibility will be necessary for the optimal location of local-area systems given the multilayered use of the 902-928 MHz

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[43](...continued)
exclusive licensing regimes, such as public notices announcing cut-off dates after an initial application had been received or a notice establishing a filing window. Operations in the 902-903 and 926-927 MHz bands are on a developmental basis. Some AVM operations occur today in the 912-918 MHz band on a waiver basis.

[44] *Automotive Vehicle Locator Systems*, 30 Rad. Reg. 2d (P&F) 1665, 1667 (1974) ("*Interim Order*").

band.[45] As noted above, AMTECH expects that similar ability to adjust to differing locations in the band would likely be beneficial to many of the so-called "wideband" systems.

Furthermore, by dividing the band into clearly marked "wideband" and "narrowband" sub-allocations, the Commission would constrict the ability of innovators of HML technology to use bandwidths greater than the "wideband" sub-band[46] and, for all practical purposes, that of developers of non-HML technology to design systems using more than 2 MHz.[47]

In contrast with the anti-sharing approach urged on the FCC by PacTel and MobileVision, AMTECH has consistently supported a regulatory environment consonant with one of the basic historical principles of private land mobile radio operation: spectrum sharing in which "all applicants and licensees . . . cooperate in the selection and use of frequencies in order to . . . make the most effective use of the

authorized facilities" and take reasonable steps to reach "mutually satisfactory arrangements" in cases of actual harmful interference.[48]

The proponents of exclusivity have pointed to the Commission's earlier rulemaking regarding replacement of Part 90 by Part 88 in support of exclusive licensing.[49] However, the Commission's proposal there does not undermine the principle of sharing, but actually serves to reinforce it in the case of AVM in the 902-928 MHz band.

In *Replacement of Part 90*, the Commission has proposed to create an "*opportunity*" for licensees in shared bands below 470 MHz to obtain channel exclusivity, called "exclusive use overlay" ("EUO").[50] In so doing, the FCC rejected approaches that would have involved a forced conversion of shared bands to exclusive use, which is what PacTel and MobileVision support in the 904-912 and 918-926 MHz sub-bands.[51]

Under EUO, the Commission would grant an EUO license "on specific channels at specific locations" only to systems that are constructed and operating, and only if

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[48] 47 C.F.R. § 90.173(b).

[49] *Replacement of Part 90* at 8108-09.

[50] *Id.* at 8109 (emphasis in original).

[51] *Id.* at 8108-09; *see Spectrum Efficiency in the Private Land Mobile Radio Bands in Use Prior to 1968*, 6 F.C.C. Rcd 4126, 4133-34 (1991) (discussion of imposing exclusivity through a freeze on licensing and by emptying bands of existing licensees). The Commission, in *Replacement of Part 90*, noted that commenters generally opposed these two plans. *Replacement of Part 90* at 8109.

each of the other existing licensees in that area concurred.[52] As exclusivity would be possible only if the other persons authorized to use the channels agree to it, the Commission does not intend to disturb the fundamental, shared nature of the bands at issue.

Furthermore, this proposal for EUO in shared bands below 450 MHz is a far cry from the position espoused by PacTel and MobileVision. PacTel seeks exclusivity for HML systems generally, whether they are constructed or not, and in disregard of whether the frequencies in a given location are already occupied by or assigned to other AVM licensees, whether local-area systems, other "wideband" wide-area licensees, or otherwise. While PacTel and MobileVision purportedly would "grandfather" such licenses, their proposal goes well beyond EUO in that new applicants for frequencies used by "grandfathered" licensees, and in the markets in which they operate, would be frozen out. Even more egregious, given the multitudinous licenses held by PacTel and MobileVision, exclusivity would effectively translate into a nationwide 16 MHz duopoly.[53]

Even more importantly, the 902-928 MHz band is fundamentally different from the bands under consideration for the EUO plan (i.e. the 150-174 and 450-470 MHz bands) in a way that favors continued sharing. The Private Land Mobile Radio

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[52] *See id.* at 8177 (proposed rule 47 C.F.R. §§ 88.171(a) and (b)) (licenses are available on a shared basis and "applicants and licensees must cooperate in the selection and use of frequencies in order to reduce interference.")

[53] This fact alone is sufficient to make the NPRM's alternate "temporary exclusivity" proposal materially different from exclusive use overlay and the private carrier paging proposal.

allocations in these lower frequency bands are, by and large, on a primary basis.[54] In marked contrast, as explained above, the AVM allocation in the 902-928 MHz band is not primary. Rather there are four levels of authorized users, with AVM third in order of priority, and the FCC has made recent efforts to encourage the development of Part 15 devices in the band.[55] In short, sharing is fundamental to this band. Accordingly, just as segregation of "wideband" and "narrowband" systems appears not to be appropriate, the 902-928 MHz band is not an appropriate candidate for an exclusive

whenever possible.[57] The FCC has also looked to spectrum sharing to increase efficiency, a position which has been reaffirmed in a host of other areas throughout the ensuing 20 years.[58] Any band plan that involves segregation of LMS system types or exclusivity for individual licensees, even temporarily, will have a chilling effect on the entire industry, reducing competition and consumer choice.

D. AMTECH's Alternative Band Plan

While AMTECH's preferred band plan would afford the Commission the most flexibility in licensing and LMS system operators the greatest choice in the selection and cooperation in the use of frequencies, AMTECH recognizes that the Commission

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[57] *Cf. Allocation of the 849-851/894-896 MHz Bands*, 5 F.C.C. Rcd 3861, 3873-74 (1990) (adopting a flexible, open entry approach where applicants chose the appropriate technology).

[58] *Establishment of a Pioneers Preference*, 6 F.C.C. Rcd 3488, 3492 (1991) (noting that an

may perceive the need for more protection for certain purportedly fragile wide-area HML systems. However, the *NPRM* goes too far by setting aside almost 60% of the spectrum solely by such systems. Despite the fact that the FCC intends to open up 8 additional MHz for LMS (902-903, 912-918, and 927-928 MHz), non-HML system

Therefore, AMTECH proposes the following alternative should the Commission determine that the public interest would be served by increasing the protection from local-area operations afforded certain wide-area systems. This alternative plan is based on three principles. First, the entire band would be shared subject to strict power or field strength limitations depending on the type of system and frequency sub-band. Second, wide-area systems needing a very low noise environment would have 4 MHz sub-bands in which to operate subject to increased protection from signals generated by local-area systems. Third, narrowband forward links, if permitted in the 902-928 MHz band, would receive no more protection than other AVM facilities operating within their designated power limitations.

Specifically, under this alternative, AMTECH proposes the following licensing and power rules as modifications to the band plan described above in order to provide more interference protection to certain wide-area systems:

- In the 907-909 and 921-923 MHz sub-bands, power from local-area readers (i.e., base stations, including highway beacons) and tags (i.e., mobiles) would both be limited to 50 mW ERP;[61]
- In the 906-907, 911-912, 920-921, and 923-924 MHz sub-bands, local-area readers and tags would be limited to 200 mW ERP and 50 mW ERP, respectively.[62]

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[61] These low-power local-area sub-bands could be used to accommodate "spill-over" from a wideband local-area systems. Thus, such systems could place no more than 50 mW ERP into these bands so as to produce a field strength of 12 dBmV/m as measured at a distance of 0.5 miles from the emitter at a height of 2 meters above ground.

[62] These low-power local-area sub-bands could be used to accommodate "spill-over" from a wideband local-area system.

See Figure 2. A plan of this type would accommodate at 906-910 MHz and at 920-924 MHz those wide-area systems requiring an unusually low noise level. Local-area operations in the 906-910 and 920-924 MHz sub-bands would be greatly restricted in power. Thus, their already small contribution to the noise floor by such systems would be diminished even further. At the same time, AMTECH's plan would provide sufficient spectrum for multiple high-data-rate systems, including the system, specified by CALTRANS, the first of such systems, and would foster a competitive environment for a variety of LMS systems.

E. Placement of Forward-links

Under the Commission's proposal, high-power 250 kHz-wide forward-links for wide-area systems would be assigned and centered in the vicinity of 905 and 925 MHz. While high powered narrow band forward links may be necessary for the operation of wide-area systems, AMTECH submits that the suggested locations would not be in the public interest for several reasons. First, while the local-area systems are not likely to be disturbed by the forward links, the reverse is not true. A mobile receiver from a wide-area system can be desensitized when in the near vicinity of a local-area reader operating on the same frequency as the forward link. This potential of interference to the wide-area systems can be limited through coordination with local-area

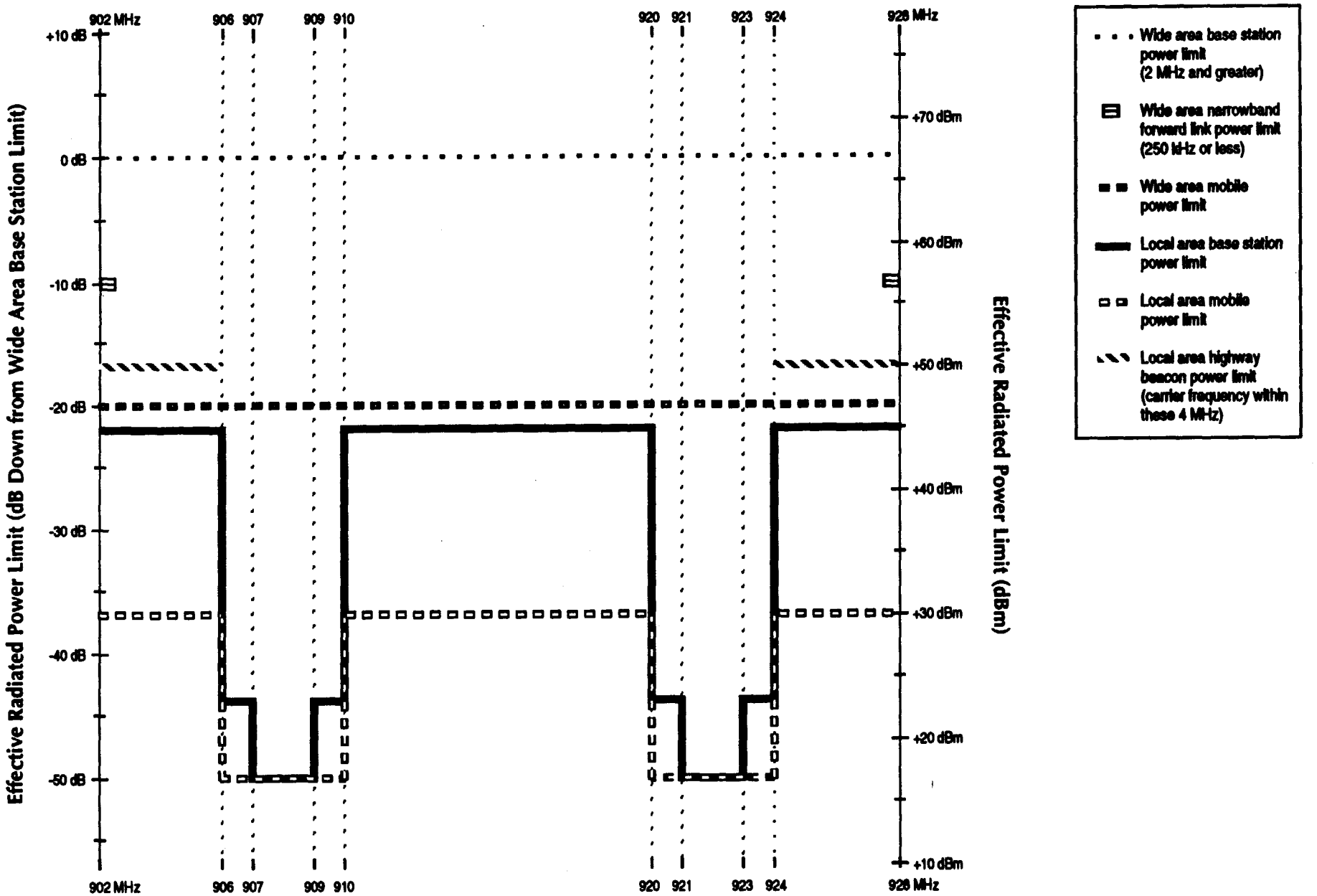

Figure 2: Proposed Power Limits for LMS Systems in the 902-928 MHz Band (Alternative Plan)

F. Power, Height and Emission Restrictions and Requirements of Robustness.

So as to further ensure the ability of LMS licensees to share the 902-928 MHz band, the Commission should adopt specific technical standards. In particular, the Commission should prescribe power and height and necessary bandwidth limitations for (1) wide-area, i.e., HML base and mobile stations, and (2) wideband local-area transmitters and tags/reflectors.

Wideband HML system power and height limitations should be established as follows: under AMTECH's band plans, HML wideband base stations should be permitted to transmit with up to 5000 W ERP.[66] Mobiles for HML systems under the preferred or alternative plan should be limited to an output of 50 watts ERP. Mobiles should transmit no more than 10 milliseconds in any 100 millisecond time period. In this way the probability of a wide-area mobile interfering with a tag-reader system when the mobile is in the latter's reading zone would be greatly decreased.

Tag-reader local-area systems such as AMTECH's must be able to read a tag when the vehicle is in the reading zone, typically for only 100 ms at high vehicle speeds. Such systems may also have to multiplex across several lanes so that one channel in a wideband local-area system can suffice. This, too, takes up time. If the wide-area pulse from a mobile unit is 10 ms or less in any 100 ms, such a signal should not be likely to interfere with the local-area system even though the wide-area

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[66] Base stations could use reasonable gain antennas of up to 10 dB to produce an ERP of 5000 watts. Wideband base stations of this power would not be likely to interfere with tag readers.

and local-area systems do not (and likely cannot) operate on a coordinated time-shared basis.

Local-area, narrowband and wideband (i.e., non-HML), systems under AMTECH's preferred plan should be required to meet the height and power restrictions noted above. Portable and mobile readers in such systems should be expressly authorized in the permanent rules. Such readers should be allowed to transmit at up to 10 watts ERP.[67]

In addition to these power and height restrictions for local-area systems, each wide-area LMS system should be required to meet a certain level of "robustness" before they can claim equal rights to protection from harmful interference pursuant to Section 90.173(b). Specifically, such criteria could be expressed in terms of a minimum number of position fixes per minute per MHz and operation in an environment characterized by a specified average noise floor. In this way, the Commission can ensure that only systems capable of operating in the unique environment of the 902-928 MHz band will be licensed, thereby ensuring a reasonable level of quality and reliability for the public from all systems.

The rules AMTECH proposes herein are designed to foster innovation. To reflect this, the Commission should explicitly retain in its rules the ability to impose

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[67] Portable readers likely would be used by law enforcement, environmental, public safety, and transportation personnel. For example, vehicles transporting hazardous cargo could be uniquely tagged. Such tags could be read when unloading or in emergency situations. The duty cycle of portable readers would be limited so that they would, at a maximum, turn off once a read is made.

additional or different technical standards on a case-by-case basis in its licensing process for new AVM approaches not specifically contemplated in the rules it adopts.

G. Provisions for Extended Implementation.

As with other private land mobile radio systems, some LMS systems are of a nature that an extension of the eight-month construction period is warranted. For example, a number of toll collection reader/tag systems run by state or local bodies are implemented over several years, as additional lanes are added to accommodate the increase in vehicles that are tagged. A multi-year cycle is often inevitable in the planning, approval, funding, purchase and construction of such systems. Other systems, such as that being implemented for the North American railroads under the auspices of the AAR are of such vast scope -- in that case over three thousand readers and almost three million tags -- that construction within eight months is simply not feasible. Still other systems may possess a complex nature or require wide-area

- The planning, approval, funding, purchase, and construction of the system require a multi-year cycle. (While this situation might most commonly arise with a state or local governmental applicant, non-governmental entities could qualify for an extended period on this basis.)

- The size, complexity, or purpose of the systems warrants an extended period.

- The coordination or integration involved in a wide-area network requires an extended period.

In considering requests for extended periods, the Commission should consider the degree to which an extension might impede competition among LMS systems.

IV. EXISTING LICENSEES SHOULD BE PERMITTED TO STAY ON THE SAME FREQUENCIES

Under the *NPRM* band plan proposal, the FCC would require existing non-HML licensees currently operating on frequencies proposed to be allocated for wideband-only use to transition to the non-HML spectrum within three years after final action in the proceeding. Of course, under the current rules, almost all AVM licenses have been granted in the proposed wideband-only spectrum. In fact, over 1300 AMTECH-equipped transmitters are now in operation, almost all between 904-912 and 918-926 MHz. The forced migration of all of these transmitters would be an extremely costly undertaking.[69]

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[69] For example, the relocation would require the physical removal of all of the over 1300 AMTECH-equipped transmitters and their replacement with transmitters operating at different frequencies. In addition to the actual hardware costs of actually acquiring new or refurbished

(continued...)

Not only will the transition to new frequencies be costly, AMTECH avers it is unnecessary. Indeed, as PacTel noted in its Petition for Rulemaking:

> [N]arrowband licensees licensed in the 904-912 MHz or 918-926 MHz bands on the day of this petition should be allowed to renew their licenses in their current band.
>
> . . . Maintaining the status quo with regard to existing AVM licensees is in the public interest because it will minimize disruption of this service to the public and assure the flow of capital necessary to expand this service to even greater numbers of users quickly and efficiently.[70]

Accordingly, whatever frequency assignment plan is adopted, the FCC should grandfather existing "narrowband" licensees on otherwise unavailable frequencies permanently.[71] A less desirable alternative, but one preferable to that set forth in the *NPRM*, would grandfather such licensees for a minimum of three years, as proposed in the *NPRM*, and only require movement to other frequencies thereafter upon a failure of the parties to resolve under Section 90.173 of the FCC's Rules a situation involving a good faith allegation of harmful interference to an LMS system authorized to use that

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[69](...continued)
transmitters, the licensee would be required to incur labor costs to actually replace the transmitters. The labor costs in the case of railroads alone could be quite substantial, since many of their transmitters are located in rural areas that are remote from the hub of their commercial operations.

[70] Pactel Petition for Rulemaking, RM No. 8013, at 35-36 (filed May 28, 1992). *See also* Comments of MobileVision, RM No. 8013, at 17-18 (filed July 23, 1992) (wideband licensee supports indefinite grandfathering).

[71] Under the AMTECH alternative plan, some existing local area systems would fall within the low-power sub-bands at 906-910 MHz and 920-924 MHz sub-bands but not be able to meet the lower power limits. Such existing licensees should be grandfathered indefinitely.

band under the permanent rules.[72] As in other cases of forced migration, the beneficiary of the move should reimburse the local-area system licensee for the licensee's reasonable direct costs incurred in making such a move.[73]

CONCLUSION

For the foregoing reasons, AMTECH supports the Commission's proposal to open the 902-928 MHz band to LMS systems on a shared basis. However, AMTECH

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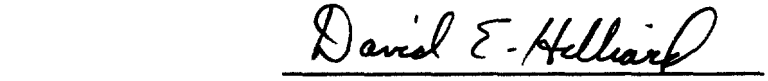
[72] Numerous local-area systems are in rural areas where it is unlikely there will be actual interference.

[73] *See, e.g., Radiodetermination Satellite Service*, 58 Rad. Reg. 2d (P&F) 1416, 1421 (1985) (RDSS licensees required to pay reasonable and prudent costs of existing grandfathered mobile operations involuntarily moved to alleviate interference) *clarified*, 104 F.C.C. 2d 637 (1986); *Redevelopment of Spectrum to Encourage Innovation in the Use of New Telecommunications Technologies*, 7 F.C.C. Rcd 6886, 6890 (1992) (emerging technology service ("ETS") provider must reimburse all relocation expenses of any microwave licensee forced to move out of its current spectrum on the ETS provider's behalf).

submits that, rather than segregating "wideband" and "narrowband" systems, the FCC should ensure access to the entire band by both local-area and wide-area systems.

Respectfully submitted,

AMTECH CORPORATION



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June 29, 1993

APPENDIX A

DESCRIPTION AND USES OF THE AMTECH TECHNOLOGY

June 29, 1993

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DESCRIPTION AND USES OF THE AMTECH TECHNOLOGY

I. DESCRIPTION OF THE AMTECH TECHNOLOGY

AMTECH provides an ideal example of how effective technology transfer from

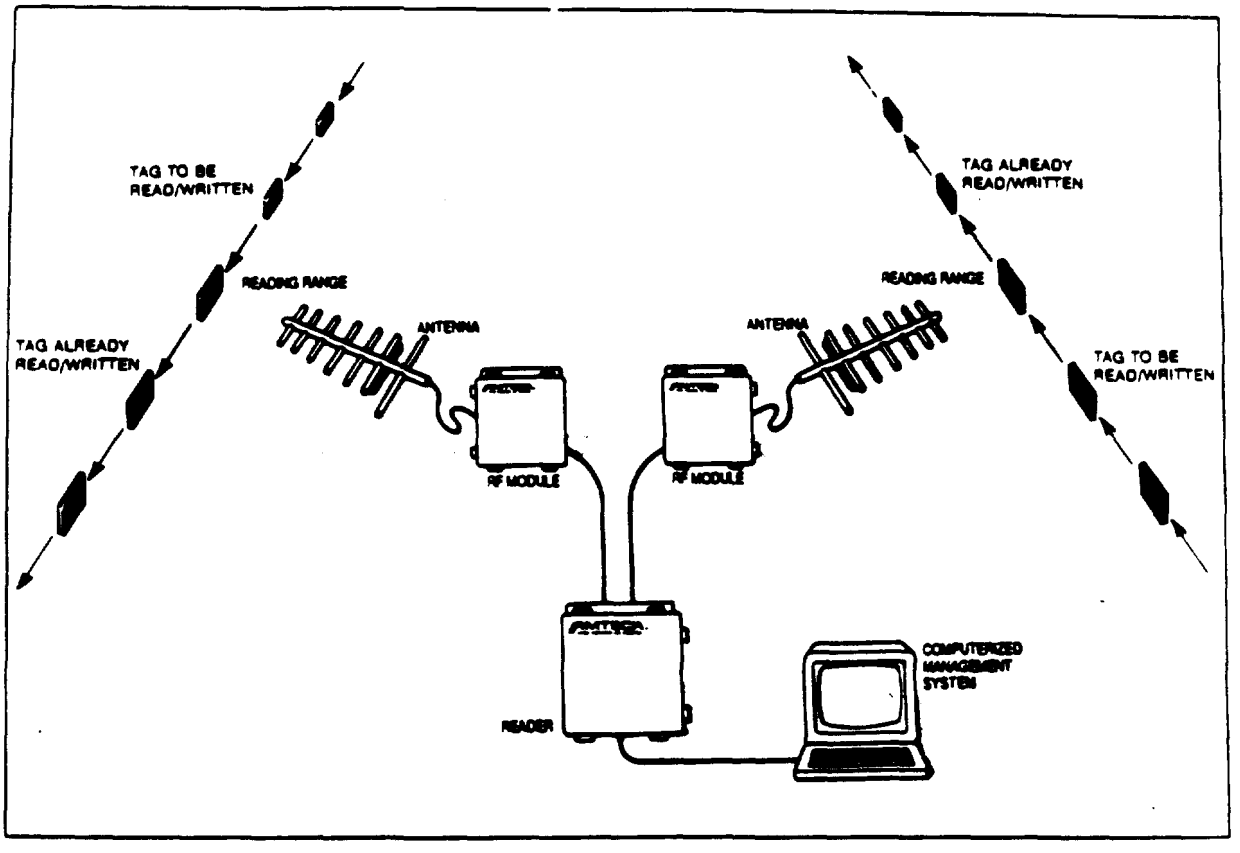
designed to control coverage area, always under 500 feet. The tag is an RF passive device.[1] Tags do not transmit radio signals; they contain no intentionally radiating oscillators. The tag is completely silent, i.e., emits no RF energy, when not in the presence of the illuminating signal. However, each tag may be programmed to carry information concerning the object to which the tag is attached.[2] Pulses transmitted by the reader are modulated and reflected back by the tag. The reflectivity of the tag antenna can be controlled digitally, by varying the efficiency of the antenna. Information stored in the tag's memory is thus used to modulate[3] the tags's pulsed reflection. This technology of reflecting energy back to a receiving unit is often described as "modulated backscatter."

The reflected pulsed signal -- which contains a true doppler signal as well as code -- is received and demodulated by the RF Module's homodyne radar receiver. The reader recognizes tags by identification of the code within the signals. The demodulated and amplified signals are passed to the reader for processing. Once data have been retrieved by the system, they must be made useful for the particular application. AMTECH's software gathers, stores, and packages the data, then

Although AMTECH readers and RF Modules are approximately the size of a briefcase, AMTECH tags can be as small as a credit card.[4] A diagram showing how a typical AMTECH installation operates is contained in Figure 1 below.

Figure 1

AMTECH AVM CONFIGURATION



The benefits of this type of technology are enormous. The tags are relatively simple in design and, thus, economical. Because the tags do not radiate signals unless

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[4] AMTECH manufactures various models with a range of sizes and shapes.

illuminated, they do not add to background electromagnetic noise levels and cannot interfere with other radio devices such as mobile telephones. The reading zone can be carefully controlled -- far easier than with tags that transmit -- resulting in reliable operations in critical applications. Tag discrimination is precise, and tag detection can be reliably accomplished even in situations where the population of tags is dense (at an automobile toll plaza, for example).[5]

Depending on the application, AMTECH's automatic vehicle monitoring ("AVM") technology uses varying amounts of spectrum. Any single reader in a "narrowband" read-only system (information flowing only from location unit's tag to the readers) requires approximately 20 kHz for its transmission. In a typical installation, this signal is transmitted at approximately 2 watts effective radiated power (ERP) or less.[6] The tag's modulated reflection is spread over a wider bandwidth, but because the tag is merely a passive reflector, a typical tag reflects less than 300 microwatts. For AMTECH's read-only systems that are currently deployed, the occupied bandwidth is approximately 2.5 MHz and the necessary bandwidth is about 800 kHz. For AMTECH's current generation of read-write systems (information flowing in both directions between the location unit's tag and the reader) the occupied bandwidth is approximately 2.5 MHz.

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[5] The reflected modulated pulse of the tag is measured to determine if the tag is within reading range, allowing the readers to read only those tags passing through their respective lanes.

[6] The maximum ERP is less than 30 watts. This level of power is employed where longer reading range is needed (e.g., certain rail, highway and intermodal environments).